NHS
University Hospitals Sussex
NHS Foundation Trust

Spinal Injuries in Children

Version:	2
Approved by:	Major Trauma Committee / Medicines Governance Group July 2021
Name of author:	Dr Miki Lazner – Paediatric Emergency Consultant and lead for Paediatric trauma Brighton hospitals
Collaborators:	Mr David Crone – Consultant Paediatric Trauma and Orthopaedic Surgeon and Lead for Trauma Christian Chadwick – Highly Specialised Pharmacist Children & Women
Name of responsible committee/individual:	Dr Miki Lazner / Trauma Committee
Date issued:	October 2021
Review date:	October 2023
Target audience:	UHSussex Trust clinicians working in RSCH / RACH / PRH
Accessibility	Brighton Microguide > Paediatrics & Neonatology > Paediatrics > Major Trauma

Spinal injuries

See also: NICE guidance NG41 Spinal injury: assessment and initial management
UHSussex Brighton hospital C-spine injuries in children guideline on Microguide > Paediatrics & Neonatology > Paediatrics > A-Z > Cervical spine injuries

Background

This guideline refers to children with known or strongly suspected spinal cord injuries. Additional guidance can be found in the C-spine injuries guideline on Microguide (see above).

Spinal cord injuries (SCI) are rare in children and require specialised care and rehabilitation. Initial management has major implication for the patient's long term management and prognosis: it is therefore important that it is done correctly from the start.

Children with spinal cord injuries must be managed by a **Paediatric neurosurgeon** or **spinal surgeon**. At UHSussex, this will necessitate a transfer as soon as is possible to a definitive referral centre. This may be the Paediatric MTC or a spinal cord injury centre (SCIC):

London Spinal Cord Injuries Centre, **Tel: 020 8954 2300**
Royal National Orthopaedic Hospital NHS Trust, Stanmore.
Paediatric Service: All ages of children and young people

National Spinal Injuries Centre, **Tel: 01296 315000**
Stoke Mandeville Hospital, Aylesbury
Paediatric Service: All ages of children and young people

University Hospital Southampton NHS Foundation Trust **Tel: 02380 777222**
Paediatric MTC
Southampton, Hampshire

Traumatic SCI should be highly suspected in the presence of abnormal neurological examination, a high-risk mechanism of injury or a distracting injury **even in the absence of radiological anomaly.**

Be aware of SCIWORA - spinal cord injury without radiographic abnormality

= Spinal cord injury without an obvious vertebral column injury.

- Injury will not be seen on plain x-rays or CT.
- Most frequently seen in younger children (especially < 8 years of age), and in the cervical spine. Incidence ranges from 1% to 10% of all spinal cord injuries in children.

In addition, children are at risk of two special problems associated with SCI:

- **Neurogenic shock** – hypotension, and bradycardia from unopposed vaso-vagal reflex in response to tracheal stimulation (see below).
- **Autonomic dysreflexia** – life-threatening hypertension response to noxious stimuli.

Manage the child with these problems in mind.

Spinal injuries should be suspected in children with:

1. A dangerous mechanism of injury:
   - road traffic collision e.g. high-speed motor vehicle collision, rollover motor accident, lap belt restraint only, ejection from a motor vehicle, accident involving motorised recreational vehicles, bicycle collision, horse riding accidents
   - A fall or jump from a height, especially if landing on head or buttocks
   - An accident resulting in impact or crush injuries, multiple trauma, or the child losing consciousness;

And / or if:

2. Following injury, the child complains of back or neck pain and appears to be guarding their back or neck
3. The child complains of any sensory or motor changes or loss such as numbness or tingling, or weakness
4. The child is unable to pass urine
5. On examination, there is / are:
   - abnormal neurological signs (motor or sensory deficit)
   - new deformity or bony midline tenderness (on palpation)
   - bony midline tenderness (on percussion)
   - midline or spinal pain (on coughing)
   - priapism
6. On mobilisation (sit, stand, step, assess walking): pain or abnormal neurological symptoms (stop if this occurs).

Assessment may be difficult where the child:

! has any significant distracting injuries
! has a reduced level of consciousness
! is under the influence of drugs or alcohol
! is confused or uncooperative

In these situations assume injury and maintain immobilisation until you are able to assess clinically.

Management

On arrival to the ED, assess and deal with <catastrophic haemorrhage>, airway (with in-line spinal immobilisation), breathing, circulation and disability as per APLS guidelines.

Airway (with in-line spinal immobilisation) and breathing

- protect C-spine if mechanism of injury suggests the possibility of cervical spine injury or patient complains of pain, tenderness or abnormal neurology (see C-spine guideline). Start with manual in-line stabilisation. If this is not possible, use head block and strapping. Get patient off spinal board ASAP. Nurse flat with spine in alignment. Use 20 degree tilt to move patient.
- If spontaneously breathing administer high flow oxygen
- Intubate and ventilate if:
  - Severe respiratory distress or inadequate respiration
  - haemodynamic instability
  - Depressed conscious state (GCS < 9) or agitation
- In obvious spinal cord injury anticipate bradycardia when intubating or suctioning due to unopposed vagal nerve stimulation. Give IV atropine (20 micrograms/kg – maximum dose 600 micrograms) and avoid succinylcholine in induction.
- Measure oxygen saturations, respiratory rate, and blood gas

Circulation

- Assess and monitor heart rate, blood pressure and capillary return
- Insert large bore intravenous cannula (ideally x 2). If unable, gain I.O access. If conscious, anticipate bradycardia during painful stimulus.
- Take trauma panel bloods
- If circulation is inadequate give intravenous fluid bolus(es)
  - 10 ml/kg crystalloid in first instance then warmed blood in 10 ml/kg aliquots. Assess response after each aliquot
  - Activate the massive haemorrhage protocol if 40 ml/kg has not stabilised the child
  - Hypotension from peripheral vasodilatation may be present due to neurogenic shock. Consider use of inotropes to support blood pressure.

Disability and environment

- Assess and monitor GCS, pupils and blood sugar
- Check core temperature
- Analgesia

Assessment of the spine should take place in the secondary survey after the airway, breathing and circulation have been assessed and stabilised.

Clinical assessment of the spine – use examination recording chart published by the American Spinal Injuries Association (ASIA Chart)

Focus on:

- Tenderness and signs of bruising or deformity over the spine
- Sensory and motor levels. Reflexes and tone.
- Sacral and perianal sensation. Anal contraction.
- Examine carefully for associated multi-system injuries, such as chest, abdominal, and pelvic injuries.

Imaging

See indications for imaging in cervical and thoracolumbar injuries below.

In children, plain films are usually the most appropriate investigation in the first instance, after careful clinical evaluation.

AP / lateral are standard views. A swimmers view may need to be obtained to visualise upper thoracic vertebrae.

In reduced consciousness, CT of the whole cervical spine (to T4) may be required.

Any suspected spinal *cord* lesion should be evaluated by MRI of whole spine.

- At UHSussex, MRI is not available out of hours but it is important to discuss with Paediatric Radiologist on call.
- A high index of suspicion is needed re disco-ligamentary injuries.
- A paediatric musculoskeletal radiologist is required for interpreting these scans.
- If MRI required out of hours, discuss with Southampton Neurosurgical team directly, or if multi-trauma and requiring MTC care, discuss with the Southampton and Oxford Retrieval Team (SORT).

Indications for imaging the cervical spine, after clinical examination (also see C-spine injury guideline on Microguide)

History of trauma and:

- GCS < 15
- Unable to assess / uncooperative
- Major distracting injury
- Major trauma
- Intoxicated / drug affected
- Focal peripheral neurology e.g. weakness or paraesthesia in the upper or lower limbs

OR

Complaining of neck pain and:

Dangerous mechanism of injury (see box 1.)

OR

Unable to safely assess range of movement in neck (see box 2.)

Box 1. Dangerous mechanism of injury:

- Fall from height > 1 metre or 5 stairs
- Axial load to head
- High speed MVC, rollover
- Ejection from a motor vehicle
- Accident involving motorised recreational vehicles
- Bicycle collision or pedestrian being struck

Box 2. Safe to assess range of movement in neck – Any 1 of:

- No focal posterior mid-line C-spine tenderness
- Involved in simple rear-end MVC
- Comfortable in sitting position in ED
- Has been ambulatory at any time since injury

Proceed to imaging

When to do a MRI?

If strong suspicion of C-spine cord or column injury as indicated by **dangerous mechanism of injury** (see box 1) or **complaining of paraesthesia in upper or lower limbs, and** by **clinical assessment** e.g. abnormal neurological signs and symptoms.

When to do CT scan?

Children **who have sustained a head injury** and

- Definitive diagnosis of cervical spine injury is needed urgently
- Patient being scanned for multi-region trauma
- Plain X-rays technically difficult or inadequate
- Strong clinical suspicion despite normal x-rays
- X-rays show a significant injury
- GCS < 13 on initial assessment
- Patient intubated
- Focal peripheral neurological signs
- Paraesthesia in the upper or lower limbs

When to do a plain x-ray?

In absence of indications for MRI or CT scan, 3 view x-rays should be obtained

Discuss x-rays with Paediatric Radiology Consultant, or if out of hours, Radiology Registrar

Indications for imaging the thoracolumbar spine

- Pain or mid-line tenderness of the spine in the thoracic or lumbar region, which is persistent after analgesia
- Significant bruising or deformity of the spine
- Clinical signs and altered conscious state
- Proven fracture in another region of the spine

When to do plain x-rays?
First line investigation in suspected injury without abnormal neurological signs or synptoms in T1-L3

When to do a CT scan?
If there are any clinical signs or symptoms of a spinal column injury, or if x-ray looks abnormal

If there is a spinal column fracture confirmed, image the whole spine.

Management of specific issues

There may be total, flaccid paralysis of all skeletal muscle and loss of all spinal reflexes below the level of the lesion (spinal shock).

1. **Pass nasogastric / orogastric tube**. Leave on free-drainage and keep child NBM. Anticipate bradycardia.

2. **Insert urinary catheter** and leave on free-drainage. Anticipate bradycardia.
   - Bladder is flaccid during spinal shock, it is important to avoid over-distension.
   - Urethral catheterisation should not be attempted in the presence of priapism. Under these circumstances suprapubic catheterisation should be undertaken in the ED.

3. **Neurogenic shock**
   The body's response to sudden loss of sympathetic control. Occurs in cervical and high thoracic lesions (above T6). Due to lack of vasomotor control, significant **hypotension** results. **Bradycardia** occurs as a result of unopposed effects of the vagus nerve.
   - Monitor ECG, BP, consider CVP
   - Monitor fluid balance.
   - Nurse patient supine
   - Maintain a normotensive systolic pressure and an adequate urinary output for age and size. Aim for 0.5ml/kg/h.
   - Administer IV fluids
   - In some instances inotropes may be necessary to maintain a stable BP.

An abnormal vaso-vagal response can occur through stimulation such as rapid changes in body positioning, i.e. log rolling too quickly, tracheal suctioning, passing an N.G. tube etc. Extreme bradycardia can result in cardiac syncope. Atropine may be given as IV bolus if the patient is unstable.

4. Autonomic Dysreflexia

This is a life threatening emergency and can result in intracranial haemorrhage and arhythmias. Tends to occur after the neurogenic shock phase.

A stimulus causes reflex sympathetic over-activity below the level of cord lesion, leading to vasoconstriction and systemic hypertension.

Peripheral vasodilatation, which would normally relieve the hypertension, cannot occur because of the injured cord. Blood Pressure continues to rise until cause removed.

Children may experience:

- Pounding headache/fullness in head
- Profuse sweating
- Tightness in chest
- Anxiety / irritability

BP elevation > 15mmHg above the child's baseline

Bradycardia, occasionally cardiac arrhythmia

Treatment algorithms exist for management in children. Contact the SCIC for more information.

5. Do not use the following medications in acute spinal cord injury

a. Methylprednisolone
b. Nimodipine
c. naloxone